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# *Indian Standard*

# SPECIFICATION FOR ALUMINIUM ALLOYS FOR I.C. ENGINE PISTONS

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# *Indian Standard*

# SPECIFICATION FOR ALUMINIUM ALLOYS FOR I.C. ENGINE PISTONS

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# *Indian Standard*

# SPECIFICATION FOR ALUMINIUM ALLOYS FOR I.C. ENGINE PISTONS

## 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 26 September 1975, after the draft finalized by the Light Metals and Their Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

**0.2** The universal acceptance of aluminium alloy pistons may be attributed to light weight and high thermal conductivity. Alloys generally used for pistons have good combination of foundry, mechanical and physical characteristics including low thermal expansion. Aluminium alloy pistons are either cast or forged.

**0.3** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

## 1. SCOPE

**1.1** This standard prescribes requirements for aluminium alloys used for the manufacture of pistons employed for internal combustion engines of all types.

## 2. SUPPLY OF MATERIAL

**2.1** General requirements relating to the supply of material shall conform to IS : 1387-1967†.

## 3. CHEMICAL COMPOSITION AND PHYSICAL PROPERTIES

**3.1** The chemical composition of aluminium alloys and physical properties of aluminium alloy pistons shall be as given in Table 1 except that the values of coefficient of thermal expansion are given for information only.

---

*Rules for rounding off numerical values ( *revised* ).

†General requirements for the supply of metallurgical materials ( *first revision* ).

## TABLE 1 CHEMICAL COMPOSITION OF ALLOYS AND PHYSICAL PROPERTIES OF ALUMINIUM ALLOY PISTONS

( *Clause* 3.1 )

( Values are in percent *Max*, unless shown otherwise )

| *ALLOY DESIGNATION | | CHEMICAL COMPOSITION, PERCENT | | | | | | | | | | | | PHYSICAL PROPERTIES† | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Casting | Forging | Cu | Mg | Si | Fe | Mn | Ni | Zn | Ti | Sn | Pb | Cr | Al | Hardness ( HB ) | Tensile Strength N/mm$^2$ ( kgf/mm$^2$ ) | | Coefficient of Thermal Expansion ( 20-200°C ) cm/cm°C × $10^{-6}$ |
| | | | | | | | | | | | | | | | Chill casting | Forging | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) |
| 2285 | 24850 | 3·5-4·5 | 1·2-1·8 | 0·6 | 0·7 | 0·2 | 1·7-2·3 | 0·2 | 0·2 | 0·05 | 0·05 | — | Remainder | 90-130 | 225-275 ( 23-28 ) | 345-410 ( 35-42 ) | 23-24 |
| 4658 | 49582 | 0·8-1·5 | 0·8-1·3 | 11·0-13·0 | 0·8 | 0·2 | 1·5‡ | 0·35 | 0·2 | 0·05 | 0·05 | — | Remainder | 90-140 | 195-245 ( 20-25 ) | 295-365 ( 30-37 ) | 20·5-21·5 |
| 4928-A | 49285 | 0·8-1·5 | 0·8-1·3 | 17·0-19·0 | 0·7 | 0·2 | 0·8-1·3 | 0·2 | 0·2 | 0·05 | 0·05 | — | Remainder | 90-125 | 175-215 ( 18-22 ) | 225-295 ( 23-30 ) | 18·5-19·5 |
| 4928-B | — | 0·8-1·5 | 0·8-1·3 | 23·0-26·0 | 0·7 | 0·2 | 0·8-1·3 | 0·2 | 0·2 | 0·05 | 0·05 | 0·3-0·6 | Remainder | 90-125 | 165-205 ( 17-21 ) | — | 17-18 |

*Alloys have been designated in accordance with IS : 6051-1970 'Code for designation of aluminium and aluminium alloys'.

†Physical properties are attainable after suitable heat-treatment.

‡The purchaser may specify a minimum nickel content, if so desired.

## 4. MICROSCOPICAL EXAMINATION

**4.1** In hyper-eutectic alloys, primary silicon cuboids shall be uniformly distributed in the eutectic matrix. Size of silicon cuboids as measured in a field of 75 mm diameter and 100 magnification shall be on an average of 40 to 70 microns and individual silicon cuboid size shall be not more than 100 microns.

## 5. CONDITION

**5.1** The piston casting/forging shall be supplied in one of the following conditions as specified by the purchaser:

Solution treated and precipitation treated ( *WP* )
Stabilized ( *S* )

## 6. SAMPLING

**6.1 Sampling for Chemical Analysis** — One sample for chemical analysis shall be taken representing each lot of 1 000 kg or as mutually agreed to between the purchaser and the supplier. For preparation of a laboratory sample for chemical analysis, reference may be made to IS : 1817-1961*. The sampling procedure for hyper-eutectic alloys is given in Appendix A for guidance.

**6.2 Sampling for Tensile and Hardness Tests** — At least one piston shall be selected from every batch. The batch is defined as a batch of pistons heat-treated together to achieve the required mechanical properties.

## 7. TESTS

**7.1 Chemical Analysis** — The chemical analysis of samples ( *see* **6.1** ) shall be carried out in accordance with IS : 504-1963†.

**7.2 Tensile Test** — Tensile test sample shall be taken from the crown portion of the piston selected under **6.2**, and tested for tensile strength according to IS : 1816-1961‡.

**7.3 Hardness Test** — Brinell hardness test as specified in IS : 1790-1961§ shall be carried out on the piston selected in accordance with **6.2**.

## 8. RETESTS

**8.1** If a sample selected fails to meet the requirements of the mechanical tests mentioned in **7**, two further test pieces which represent the same batch may be selected and tested in the same manner. If both of these test pieces meet the requirements, the material represented thereby shall be accepted.

---

*Methods of sampling non-ferrous metals for chemical analysis.

†Methods of chemical analysis of aluminium and its alloys ( *revised* ).

‡Method for tensile test for light metals and their alloys.

§Method for Brinell hardness test for light metals and their alloys.

**8.2** Alternatively, the supplier may re-heat-treat the batch once only, before the two further samples are selected.

## 9. MARKING

**9.1** The material shall be so marked that it is fully identified. The supplier shall furnish a certificate that the material supplied complies with the requirements of this specification.

**9.2** The material may also be marked with the ISI Certification Mark. The supplier's certification ( *see* **9.1** ) shall be implied if the material is certified under the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution ( Certification Marks ) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

# APPENDIX A

( *Clause* 6.1 )

## SAMPLING PROCEDURE FOR HYPER-EUTECTIC ALLOY

**A-1.** Drillings shall be taken with a sharp high speed steel drill running at low speed, approximately 30 rev/min. Pressure applied shall be low and drillings shall be collected on a glazed paper. Drillings shall be sieved through various sieves weighing accurately, the amount retained on each sieve. A proportional weight shall be taken from the samples from each sieve to make up the total weight of sample for analysis. The casting shall be drilled right through from top to bottom.

( *Continued from page* 2 )

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SP : 1-1967 Comparison of Indian and overseas standards on aluminium alloy castings

IS:

| | |
|---|---|
| 20-1959 | Cast aluminium and aluminium alloy for utensils ( *second revision* ) |
| 21-1975 | Wrought aluminium and aluminium alloy for manufacture of utensils ( *third revision* ) |
| 617-1975 | Aluminium and aluminium alloy ingots and castings for general engineering purposes ( *second revision* ) |
| 733-1975 | Wrought aluminium and aluminium alloys, bars, rods and sections ( for general engineering purposes ) ( *second revision* ) |
| 734-1975 | Wrought aluminium and aluminium alloys, forgings stock and forgings ( for general engineering purposes ) ( *second revision* ) |
| 736-1974 | Wrought aluminium and aluminium alloys, plate ( for general engineering purposes ) ( *second revision* ) |
| 737-1974 | Wrought aluminium and aluminium alloys, sheet and strip ( for general purposes ) ( *revised* ) |
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| 739-1966 | Wrought aluminium and aluminium alloys, wire ( for general engineering purposes ) ( *revised* ) |
| 740-1966 | Wrought aluminium and aluminium alloys, rivet stock ( for general engineering purposes ) ( *revised* ) |
| 1253-1965 | Aluminium for use in iron and steel manufacture ( *revised* ) |
| 1254-1975 | Corrugated aluminium sheet ( *second revision* ) |
| 1284-1975 | Wrought aluminium alloys, bolt and screw stock ( for general engineering purposes ) ( *second revision* ) |
| 1285-1975 | Wrought aluminium and aluminium alloys, extruded round tube and hollow sections ( for general engineering purposes ) ( *second revision* ) |
| 1820-1963 | Recommended shapes and sizes of aluminium notched bars and ingots for remelting purposes |
| 1841-1971 | EC grade aluminium rod produced by rolling ( *first revision* ) |
| 2047-1962 | Aluminium alloy hardeners ( master alloys ) |
| 2067-1975 | Wrought aluminium wire ( *second revision* ) |
| 2525-1963 | Diameters of wrought aluminium and aluminium alloys, wire |
| 2590-1964 | Primary aluminium ingots for remelting for general engineering purposes |
| 2673-1964 | Dimensions for wrought aluminium and aluminium alloys, extruded tube ( round ) |
| 2676-1964 | Dimensions for wrought aluminium and aluminium alloys, sheet and strip |
| 2677-1964 | Dimensions for wrought aluminium and aluminium alloys, plate |
| 2678-1972 | Dimensions for wrought aluminium and aluminium alloys, drawn tube ( *first revision* ) |
| 3577-1969 | Diameters of wrought aluminium and aluminium alloys, rivet, bolt and screw stock |
| 3965-1969 | Dimensions for wrought aluminium and aluminium alloys, bar, rod and section |
| 5047 ( Part I )-1969 | Glossary of terms for aluminium and aluminium alloys: Part I Unwrought and wrought metals |
| 5052-1969 | Temper designations of aluminium and its alloys |
| 6051-1970 | Code for designation of aluminium and its alloys |
| 6477-1972 | Wrought aluminium and aluminium alloys, extruded hollow sections |
| 6751-1972 | Aluminium alloy castings and strips for bearings |
| 6754-1972 | Aluminium alloy ingots for bearings |
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# IS: 7793-1975 SPECIFICATION FOR ALUMINIUM ALLOYS FOR I. C. ENGINE PISTONS

## Alterations

( *Page* 3, *clause* **3.1** ) — Substitute the following for the existing clause:

'**3.1** The chemical composition o aluminium alloys for pistons shall ber as given in Table 1. The physical properties and the values of co-efficient of thermal expansion for the alloys are given in the table for guidance only.'

( *Page* 4, *Table* 1 ):

a) *Caption* — Substitute the following for the existing caption:

**'TABLE 1 CHEMICAL COMPOSITION AND PHYSICAL PROPERTIES OF ALUMINIUM ALLOYS FOR PISTONS'**

b) *Col* 1 *and* 2, *second entry* — Substitute '4625' *and* '46258' *for* '4658' and '49582' respectively.

c) *Foot-note with* '†' *mark* — Substitute the following for the existing foot-note:

'†Physical properties are attainable after suitable heat treatment of separately cast or forged test bars. The tensile strength attainable on test pieces taken from he crown portion of the piston shall generally be lower by 25 N/mm² than those pecified in the table.'

( *Page* 5, *clause* **6.2** ) — Substitute the following for the existing clause:

'**6.2 Sampling for Tensile and Hardness Tests** — At least one separately cast test bar sample may be taken from each supply batch for tensile test and atleast one piston shall be selected from each supply batch for hardness test.'

( *Page* 5, *clause* **7.2** ) — Substitute the following for the existing clause:

"**7.2 Tensile Test** — Tensile test may be carried out on a separately cast test bar selected in accordance with **6.2** and tested for tensile strength according to IS : 1816-1961 'Method for tensile test for light metals and their alloys'."

(SMDC 10)

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